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Ohio and Competing Processing Tomato Supply States

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Ohio and Competing Processing Tomato Supply States

CHAN CONNOLLY and M. E. CRAVENS

INTRODUCTION

This bulletin reports a study of trends in reference to Ohio's relative position as a supplier of processing tomato raw stock in the United States over the 12-year period, 1954-1965. Using this information as a point of departure, Ohio's future position as a supplier of processing tomato raw stock is projected into the next 5-year period, 1966-1970.

Graphs in this bulletin measure levels and rates of change over a time period by using average straight lines.[1] These linear trend regression lines were derived by the use of a least squares equation. Straight trend lines in the graphs enable readers to interpret more easily the levels and rates of change. An analysis of the data in Figure 1 indicates two methods which may be used to present the real price[2] processors paid growers for processing tomatoes in Ohio and California over the 27-year period, 1939-1965. First, real prices for Ohio and California are presented as year-to-year prices. Second, an average straight line indicates the level and rate of change during this period.

Graphs in this publication are used to compare each of the 12 major supply states for levels and rates of change. Three linear trend regression lines are presented in many of the individual graphs. Ohio's linear trend regression line is presented in each graph as a reference.

Predictions to 1970 are made by projecting the linear trend regression lines. These predictions appear as dotted lines for the period 1966-1970 in each graph. Due to changes which are expected to occur during this period, 1966-1970, levels and slopes of the projected linear trend regression lines are often not the same as that of the historical period 1954-1965.

The Ohio tomato processing industry, including processors, growers, research workers, government agents, and others, may be able to use this material as guidelines in providing direction to future activities in the Ohio processing tomato industry.

[1]Least squares regression, frequently referred to as linear trend regression lines.

[2]Real price is a computed price based on the reported yearly average price with the inflationary and deflationary influences removed. This is accomplished by the use of index numbers. Real prices have constant purchasing power and the real price for any year is directly comparable with that for any other year. The wholesale price index 1957-59 = 100 was used in this study for computing real prices.

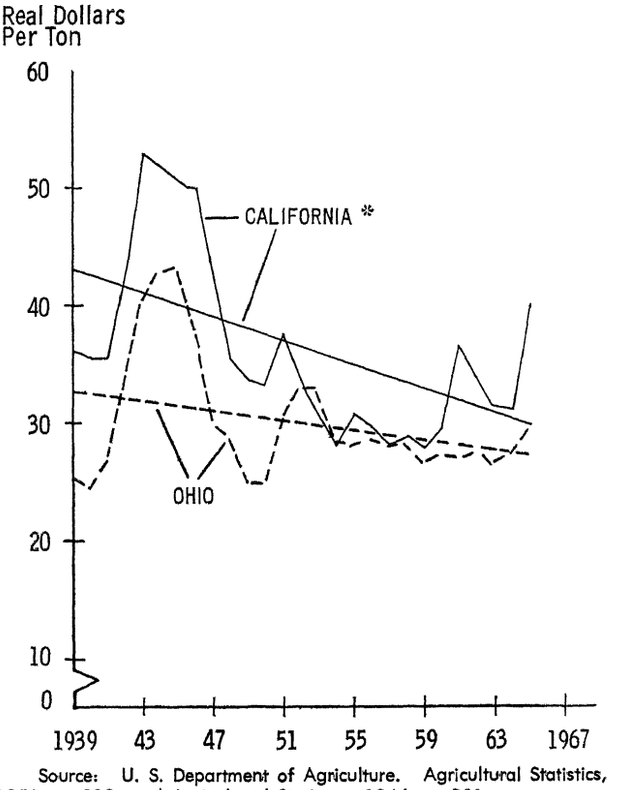
Prices of processing tomatoes reported by the U. S. Department of Agriculture are referred to as nominal prices. Real prices are computed by removing the inflationary and deflationary influences from nominal prices. Real prices are also often referred to as deflated prices.

TOTAL U. S. DEMAND FOR PROCESSING TOMATOES

Per Capita Consumption and Population Growth

Total demand for processing tomatoes in the United States during the 2-year period, 1964-1965, was about 4.5 million tons of raw stock per year (Table 1). Total demand increased at an annual rate of 64,400 tons per year during the 12-year period, 1954-1965.

Fig. 1.—Real Prices of Ohio and California Processing Tomato Raw Stock Presented as Annual and Average Trend Lines for the 27-Year Period, 1939-65 (1957-59 = 100).



Source: U. S. Department of Agriculture. Agricultural Statistics, 1950, p. 288, and Agricultural Statistics, 1966, p. 201.

*Statistical Crop Reporting Board, U. S. Department of Agriculture, reported all California prices on basis of "roadside pick-up" prior to 1964. Starting with 1964, California prices were reported on basis of delivered price to processing plant. Consequently, all California prices prior to 1964 are adjusted to include transfer cost to processing plant and are comparable with Ohio prices.

TABLE 1.—Total Production, Per Capita Consumption of Processing Tomatoes, and Population in the United States, 1954-65.

Year	U.S. Total Production	U.S. Population	U.S. Per Capita Consumption
	Millions of Tons	Millions	Raw Stock Lb.
1954	2.7	162	38.16
1955	3.3	165	41.26
1956	4.6	168	42.12
1957	3.3	171	42.56
1958	4.3	174	43.51
1959	3.6	177	44.25
1960	4.0	181	45.40
1961	4.2	184	46.33
1962	5.4	187	47.31
1963	4.1	189	49.22
1964	4.6	192	47.89
1965	4.4	195	48.80

Source: U. S. Department of Agriculture, Economic Research Service, U. S. Food Consumption, 1909-63. Stat Bull. 364, p. 42; and U. S. Food Consumption Supplement for 1965. Stat. Bull. 364, p. 12.

U. S. per capita consumption of processing tomatoes has increased steadily. Per capita consumption reached a level of about 48 lb. during the 3-year period, 1963-1965, as measured in terms of raw stock marketed at the farm level (Table 1). The average per capita rate of increase in consumption for the 12-year period, 1954-1965, was 0.45 lb. per year (Table 2 and Figure 4).

The present U. S. per capita annual consumption of processed tomato products, in terms of raw stock equivalent, is about 48 lb. and that for fresh tomatoes is 12.5 lb., or a total of 60.5 lb. farm weight equivalent.

The average annual net rate of population growth in the United States was about 1.7 percent for the period 1954-1965. The net rate of population growth is expected to be about 1.5 percent in the period 1966-1970, according to the best estimates.

With the increase in per capita consumption and the increase in population, total U. S. demand for processing tomatoes increased from 2.7 million tons in 1954 to 4.5 million tons for the period 1964-1965, as shown in Table 1 and Figure 5A.

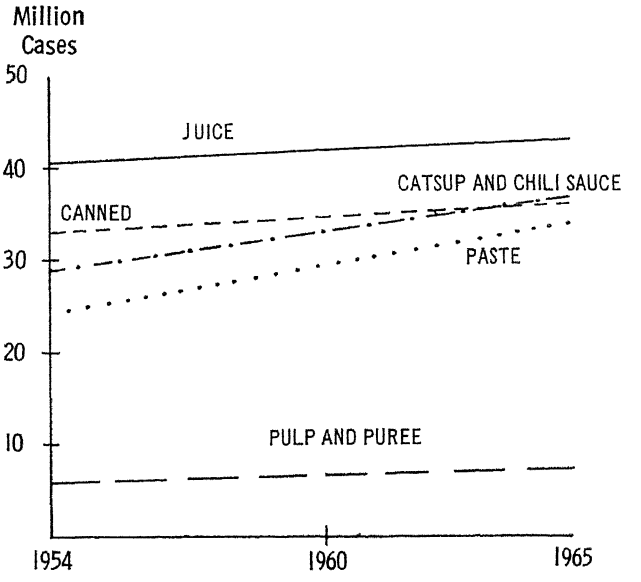
Total demand for processing tomatoes in the United States is expected to reach a level of about 4.7 million tons by 1970 (Figure 5A). Projections are made for each of 12 supply states, indicating the expected trend in total production for the period 1966-1970.

TABLE 2.—U. S. Annual Average Per Capita Consumption of Processing and Fresh Tomatoes and Rate of Change, 1954-65.

Sector	Average Annual Per Capita Consumption	Annual Rate of Change in Per Capita Consumption
	Farm Weight Lb.	Farm Weight Lb.
Processed	45.7	.45
Fresh	12.6	—.03
Total	57.3	.42

Source: Computed from data published by U. S. Department of Agriculture, Economic Research Service, U. S. Food Consumption, 1909-63. Stat. Bull. 364, p. 42; and U. S. Food Consumption Supplement for 1965, Stat. Bull. 364, p. 12.

Fig. 2.—Tomato Products Processed in the United States, 1954-65.

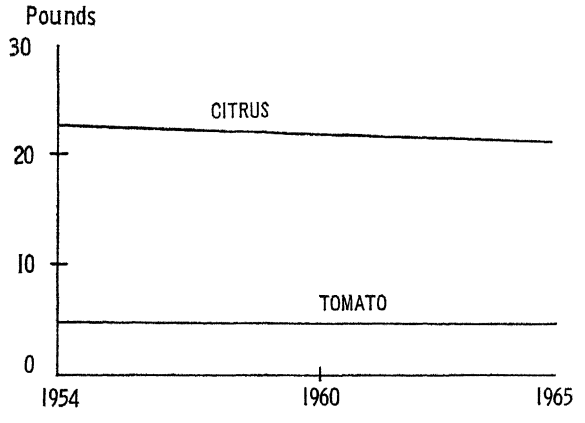


Source: U. S. Department of Agriculture. Agricultural Statistics, 1966, p. 206.

Utilization of Processing Tomato Raw Stock

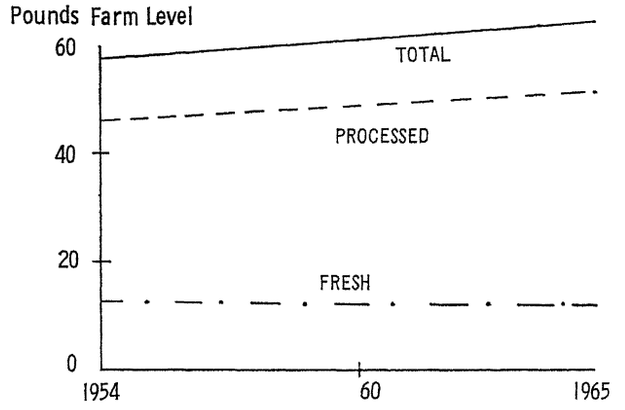
More processing tomato raw stock is used in the United States for the manufacture of tomato juice than for any other product. Canned tomatoes and

Fig. 3.—Per Capita Consumption of Citrus and Tomato Juices, 1954-65.



Source: U. S. Department of Agriculture. Agricultural Statistics, 1966, p. 207.

Fig. 4.—Per Capita Consumption of Fresh, Processed, and Total Tomatoes, 1954-65.



Source: U. S. Department of Agriculture, Economic Research Service. U. S. Food Consumption, 1909-63, Stat. Bull. 364, p. 42; and U. S. Food Consumption Supplement for 1965, Stat. Bull. 364, p. 12.

catsup are tied for second place, followed by tomato paste, pulp, and puree.

Demand for raw stock in the manufacture of catsup and chili sauce increased faster than for any other product during the 12-year period, 1954-1965 (Figure 2).

Citrus Juices and Tomato Juice

Just prior to 1940, consumption of citrus juices and tomato juice in the United States was about equal. However, the current per capita consumption of citrus juices is approximately five times that of tomato juice (Figure 3). During the period 1954-1965, per capita consumption of citrus juices declined slightly while the per capita consumption of tomato juice remained about constant.

PRODUCTION, ACRES, YIELDS, AND QUALITY

Sources of Supply

The production of processing tomatoes raw stock supply in the United States is concentrated in a few states. In 1965, nine states provided 96 percent of the total supply, with 82 percent being supplied by only four of these states (Table 3). The state of California supplied 57 percent of the total, Ohio 12 percent, New Jersey 8 percent, and Indiana 6 percent.

The relative amounts of total raw stock supplied by each state have changed materially since 1939. Since the period 1930-1939, the percent of the total supply from California increased threefold. During this same period, Ohio doubled. However, Indiana decreased from 25 percent in 1939 to 6.0 percent in 1965 and New Jersey decreased from 10.6 to 7.6 percent during the same period. Ohio, with about 5 percent of the total U. S. population and 12 percent of the production of processing tomatoes, appears to be producing at least twice its requirements.

TABLE 3.—Proportion of Processing Tomatoes Produced in 12 Major Supply States, 1930-39, 1940-49, 1950-59, 1960-64, and 1965.

	1930-39	1940-49	1950-59	1960-64	1965
	Percent	Percent	Percent	Percent	Percent
California	18.3	32.7	54.0	59.6	56.8
Ohio	6.1	6.4	5.7	8.1	11.8
New Jersey	10.6	7.3	6.4	6.6	7.6
Indiana	25.1	16.3	7.8	6.3	6.0
Pennsylvania	3.6	5.3	4.8	3.1	2.8
Illinois	1.7	2.0	3.1	3.0	2.8
Maryland	11.0	7.8	3.2	2.2	2.3
New York	7.5	5.4	4.0	2.3	2.0
Michigan	1.3	1.5	1.9	1.8	1.9
Virginia	3.6	3.4	1.6	1.2	1.5
Texas	**	1.6	1.3	.8	1.0
Delaware	2.5	1.6	.9	.6	.6
Other States	8.7	8.7	5.3	4.4	2.9
Total	100.0	100.0	100.0	100.0	100.0

Source: Computed from data published by U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington, D. C., Vegetables-Processing Annual Summaries.
**No record.

Ohio made the greatest percentage change as a supplier of raw stock. During the period 1954-1965, Ohio's annual increase averaged 13,600 tons per year. This represents a 4.5 percent average annual rate of change (Table 4).

Figures 5A through 5F present the levels of raw stock supplied and rates of change during the 12-year period, 1954-1965, for each of the 12 states and projections for the period 1966-1970.

TABLE 4.—Average Annual Total Supply and Average Annual Rate of Change in Supply for Processing Tomatoes in the U. S., Ohio, and 11 Other Major Supply States, 1954-65.

Source of Supply	Average Supply 1954-65	Average Annual Rate of Change 1954-65	1954-65
	Thousands of Tons	Thousands of Tons	Percent
Ohio	301.6	13.6	4.5
Total U. S.	4034.8	64.4	1.6
California	2370.4	42.7	1.8
Illinois	126.8	1.6	1.3
Michigan	75.0	1.2	1.6
New York	103.3	—0.7	—0.7
Pennsylvania	145.1	—1.3	—0.9
New Jersey	249.5	6.4	2.6
Delaware	29.4	—0.4	—1.4
Maryland	91.1	0.8	0.9
Virginia	50.7	0.6	1.2
Indiana	269.0	1.2	0.4
Texas	43.0	—0.6	—1.4

Source: Computed from data published by U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington, D. C., Vegetables-Processing Annual Summaries.

TABLE 5.—Average Acreage and Annual Rate of Change for Processing Tomatoes in U. S., Ohio, and 11 Other Major Supply States, 1954-65.

State	Average Annual Acreage 1954-65	Average Annual Rate of Change 1954-65	1954-65
	Acres	Acres	Percent
Ohio	19,967	499	2.5
United States	297,167	—5,315	—1.8
California	133,650	2,512	1.9
Illinois	9,025	—202	—2.2
Michigan	6,650	—94	—1.4
New York	10,500	—645	—6.1
Pennsylvania	14,950	—1,429	—9.6
New Jersey	19,350	—823	—4.3
Delaware	2,717	—352	—13.0
Maryland	9,900	—560	—5.7
Virginia	10,025	—575	—5.7
Indiana	25,158	—1,221	—4.9
Texas	11,825	—1,321	—1.1

Source: Computed from data published by U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington, D. C., Vegetables-Processing Annual Summaries.

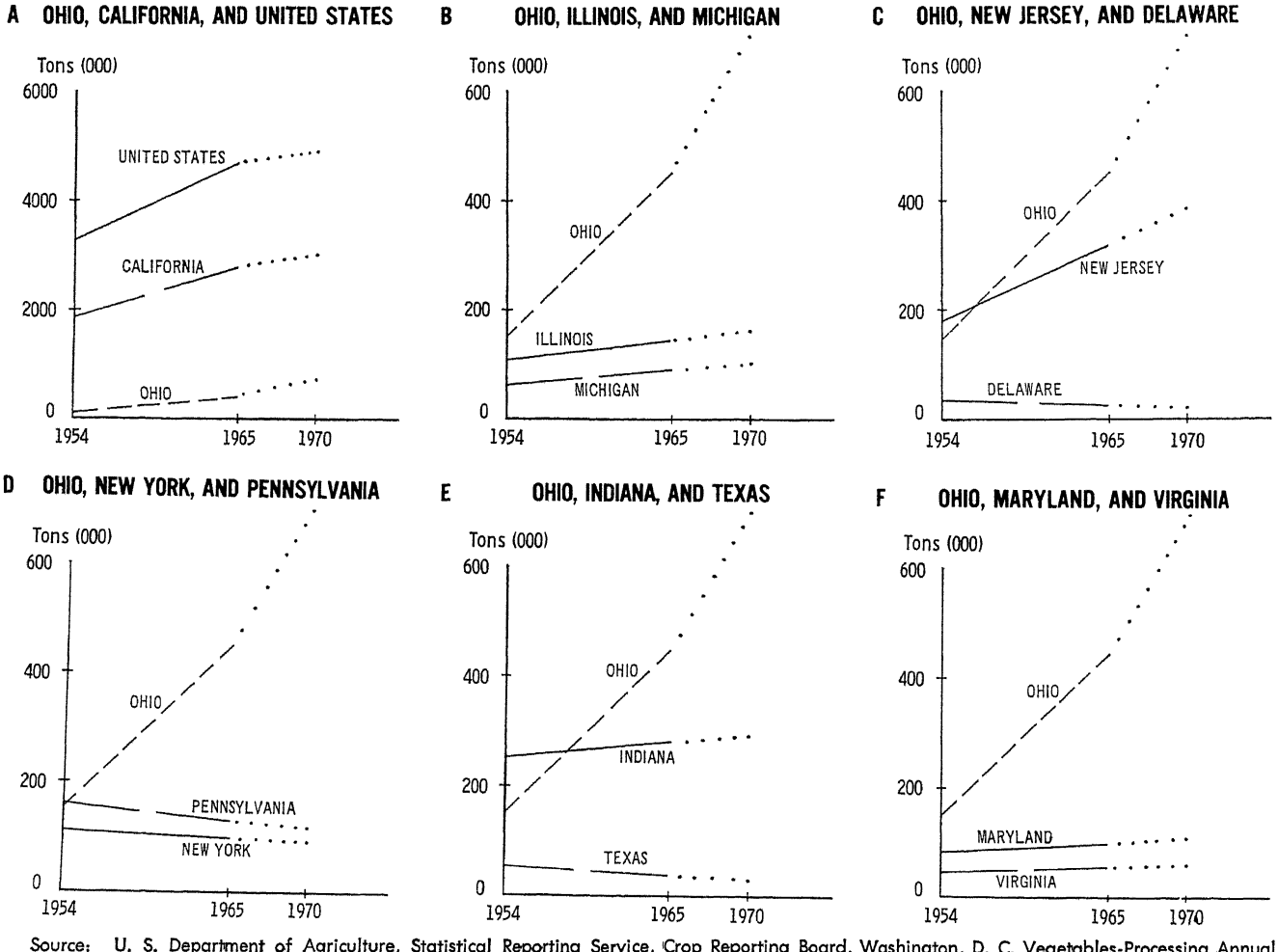
Acres and Yields

Acres: Acreage in the United States used for producing the total supply of processing tomatoes has decreased at a rate of 5,315 acres per year during the period 1954-1965. This represents a 1.8 percent annual decrease in acreage (Table 5).

During this 12-year period, 1954-1965, all major supply states experienced a decrease in total acreage with the exception of California and Ohio, where acreages increased. California's annual rate of acreage increase was 2,512 acres compared to Ohio's 499. California experienced the largest absolute rate of acreage increase. However, Ohio's percentage annual increase was 2.5 compared to California's 1.9.

There is no indication that this major shift which occurred among processing tomato producing states during the period 1954-1965 will not continue. These changes are presented in Table 5 and Figures 6A - 6F, with projections for each of 12 supply states

Fig. 5.—Trends in Processing Tomato Production, Ohio and Major Supply States, 1954-65, with Projections to 1970.



Source: U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington, D. C. Vegetables-Processing Annual Summaries.

indicating the expected trends in acreage for the period 1966-1970.

Yields: The most striking and obvious recent change occurring among states supplying processing tomatoes is the increased yield per acre as measured by tons of raw stock harvested and delivered to processors. Yield per acre is the most important variable influencing production efficiency.

During the 12-year period, 1954-1965, the average annual rate of yield increase for the United States was 0.72 tons per acre. For this same period, Ohio's average annual rate of yield increase was 0.99 tons per acre. This rate of increase is almost three times as great as that for California (Table 6). Only two states, New Jersey and Delaware, have had greater increases in yields during this period than Ohio.

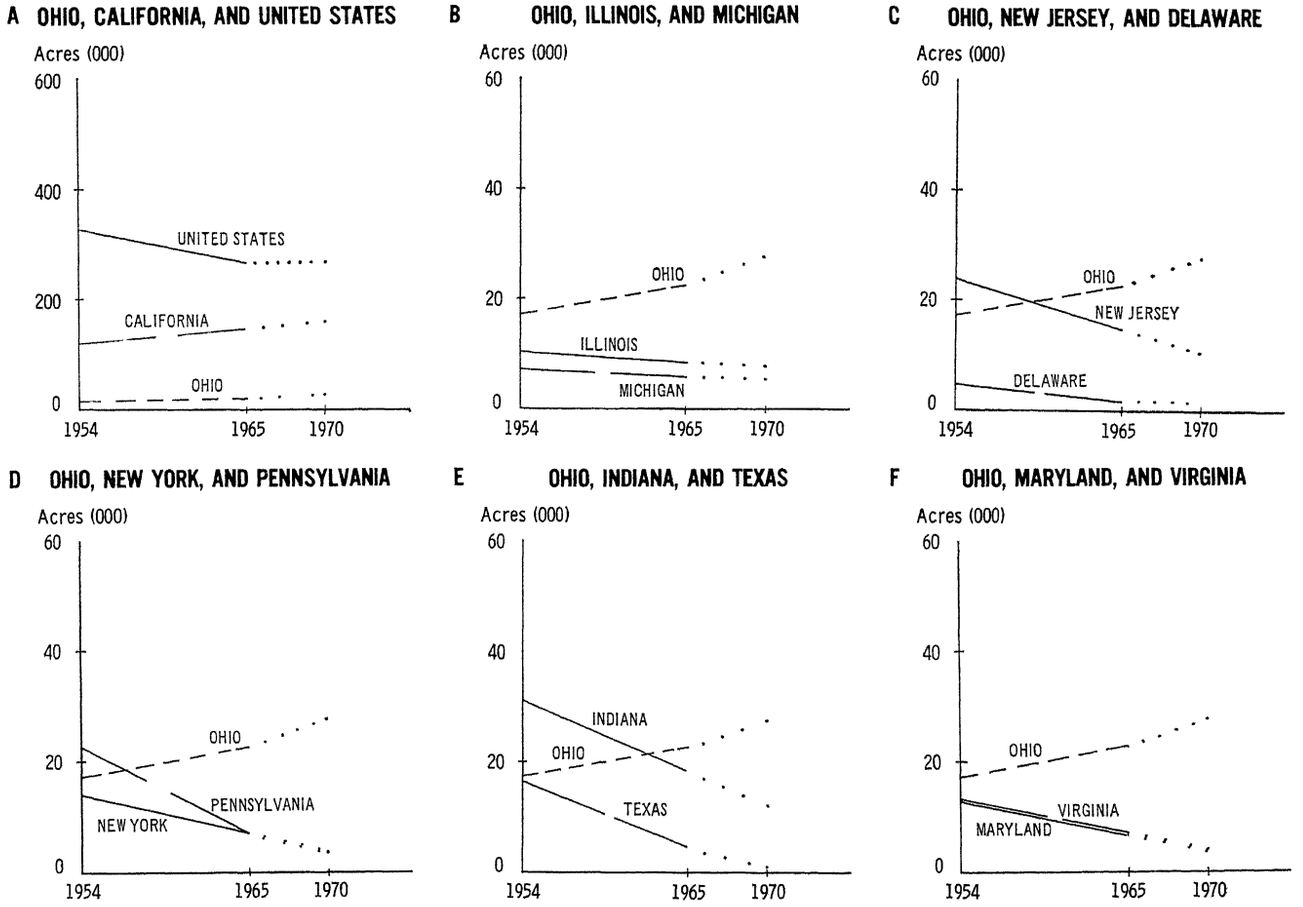
The yield levels and rates of change are presented in Figures 7A - 7F for the major supply states for the 12-year period, 1954-1965. Yield projections for each supply area are represented by the dotted

TABLE 6.—Average Yield per Acre and Average Annual Rate of Yield Increase of Processing Tomatoes for U. S., Ohio, and 11 Other Major Supply States, 1954-65.

State	Average Annual Yield per Acre 1954-65	Average Annual Rate of Yield Increase 1954-65	1954-65
	Tons	Tons	Percent
Ohio	14.89	0.99	6.6
United States	13 75	0.72	5.2
California	17.53	0.34	1.9
Illinois	10.41	0.69	6.6
Michigan	11.38	0.56	4.9
New York	10.25	0.44	4.3
Pennsylvania	10.50	0.74	7.0
New Jersey	13.48	1.13	8.4
Delaware	12.93	1.07	8.3
Maryland	9.73	0.73	7.5
Virginia	5.37	0.44	8.2
Indiana	11.13	0.70	6.3
Texas	4.08	0.34	8.3

Source: Computed from data published by U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington, D. C., Vegetables-Processing Annual Summaries.

Fig. 6.—Trends in Processing Tomato Acreage Harvested, Ohio and Major Supply States, 1954-65, with Projections to 1970.



Source: U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington, D. C. Vegetables-Processing Annual Summaries.

lines. Ohio's yield is expected to continue to increase at the annual rate of about 1 ton per acre for the next 5-year period, 1966-1970, due to the continued use of new advances in technology by growers.

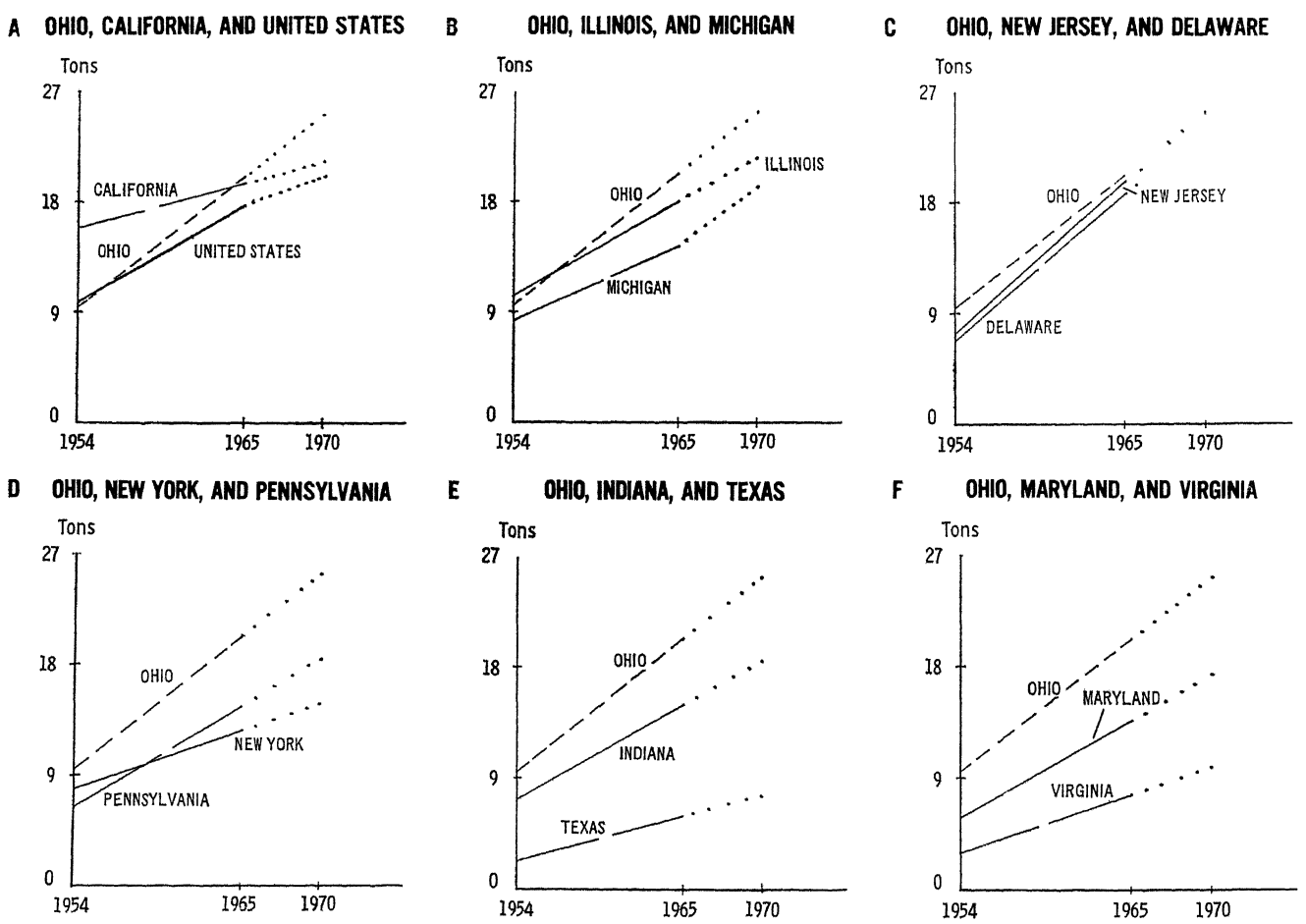
Quality of the Raw Stock Supply in Midwest and Eastern Supply States

Development of Quality Standards: The first U. S. standards for processing tomato grades were initiated in 1926 by the U. S. Department of Agriculture. These standards were developed to measure tomato raw stock quality for manufacture of strained tomato products. In 1938, U. S. standards for canning tomatoes were developed. These raw stock standards grade the raw product into three components: U. S. No. 1, U. S. No. 2, and culls. The principal difference between the two standards is in the provisions for "stems." The U. S. No. 1 canning grade permits stems while the strained products grade does not. As harvesting labor became more scarce, buyers of raw stock using the strained products standards sometimes made provisions in their contracts permitting stems on U. S. No. 1 tomatoes. There is no significant difference between the two standards as they are now being used in Ohio. These standards were applied by all Ohio tomato processors using U. S. grades in 1965 with the exception of one chain processor.

In 1957, the U. S. Department of Agriculture developed standards for grades for the Italian type tomato for canning. This standard, which has not been used in Ohio, also divides the raw product into three components: U. S. No. 1, U. S. No. 2, and culls.

One of the crucial tests applied to raw stock by government inspectors is that of color. To meet the minimum grade requirement for U. S. No. 1, the tomato must have at least 90 percent good red color and at least two-thirds good red color for a U. S. No. 2. Since there was no objective method for measuring good red color, numerous disputes developed between growers and processors concerning the measurement of color.

Fig. 7.—Comparison of Yields of Processing Tomatoes per Acre, Ohio and Major Supply States, 1954-65, with Projections to 1970.



Source: U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington, D. C. Vegetables-Processing Annual Summaries.

With the later development of a machine capable of objectively measuring color, a new grade standard has been developed by the U. S. Department of Agriculture. This standard provides for the government inspector to classify the raw product in respect to defects, as done previously, while color is measured by a colorimeter. The new standards define the following four grades as Category A, Category B, Category C, and culls.

In 1964 and 1965, one processor in Ohio used the new standards for grade evaluation of tomato raw stock. The Fresh Products Standardization and Inspection Branch, Fruit and Vegetable Division, Consumer and Marketing Service, U. S. Department of Agriculture, reports that the new standards are a definite improvement compared to the previous standards, primarily because of the objective method of measuring color. The Federal grading service expects more buyers to employ the new standards for grading raw stock in the future.

Raw Product Grade Standards: The quality determination of tomatoes for processing is made only upon request of the processor or buyer. Ohio contracts normally provide for both the seller and buyer to share the cost of inspection. The buyer typically deducts 10 cents per ton for all raw stock delivered by the grower for the grower's share of the inspection cost.

U. S. grade standards are used in most processing tomato states except California. California uses a minimum state grade standard. The province of Ontario, Canada, uses grade standards which are similar to those administered by the U. S. Department of Agriculture.

Use of the U. S. grade standards for processing tomato raw stock is voluntary. In 1965, five out of six chain processors in Ohio plus 13 independent processors employed the services of Federal-State inspectors for grading raw stock. It is estimated that about 75 to 80 percent of Ohio's 1965 total raw stock supply was graded by Federal-State inspectors. The balance of Ohio's output was graded according to minimum grades developed and administered by the buyer.[3] Such grades normally provide only for the determination of merchantable and unmerchantable or cull tomatoes. The grower receives no payment for cull tomatoes and, in addition, loads which exceed a given percentage of culls, as provided for in the contract, may be rejected by the buyer.

When U. S. grades are used, growers are typically paid a specified price per ton for U. S. No. 1 raw stock tomatoes and another price for No. 2 raw stock in accordance with provisions in the contract. Since the spread in price between No. 1 and No. 2 is frequently $8 to $10 per ton, grading of raw stock not only measures quality but also has a great influence on the average price per ton paid to the grower.

Processing tomatoes purchased from growers by brokers typically are not graded. The broker usually pays a flat price per ton of raw stock F.O.B. farm. The contract may provide for a deduction for culls.

Quality Measurements: The average grade of processing tomatoes supplied from Ohio for the 12-year period, 1954-1965, was 64 percent U. S. No. 1, 33.6 percent No. 2, and 2.4 percent culls (Table 7). During this same period, the percentage of the Ohio tomato crop graded U. S. No. 1 increased at the rate of 1 percent annually, while the percentage graded U. S. No. 2 and culls combined decreased at the rate of 1 percent.

Quality of raw stock supplies from Ohio, New Jersey, New York, Illinois, and Indiana for the 12-year period, 1954-1965, is presented in Figures 8A-

TABLE 7.—Percentage of Raw Tomatoes for Processing in Each Grade and Average Annual Rate of Change of Grade in Ohio, Illinois, Indiana, New York, and New Jersey, 1954-65.

State	U. S. No. 1 Grade: Percent of Total	U. S. No. 1 Grade: Percent Annual Change
Ohio	64.0	1 0
Illinois	68.9	—0.9
Indiana	61.0	—0 1
New York	57.1	1 1
New Jersey	64.0	1 1

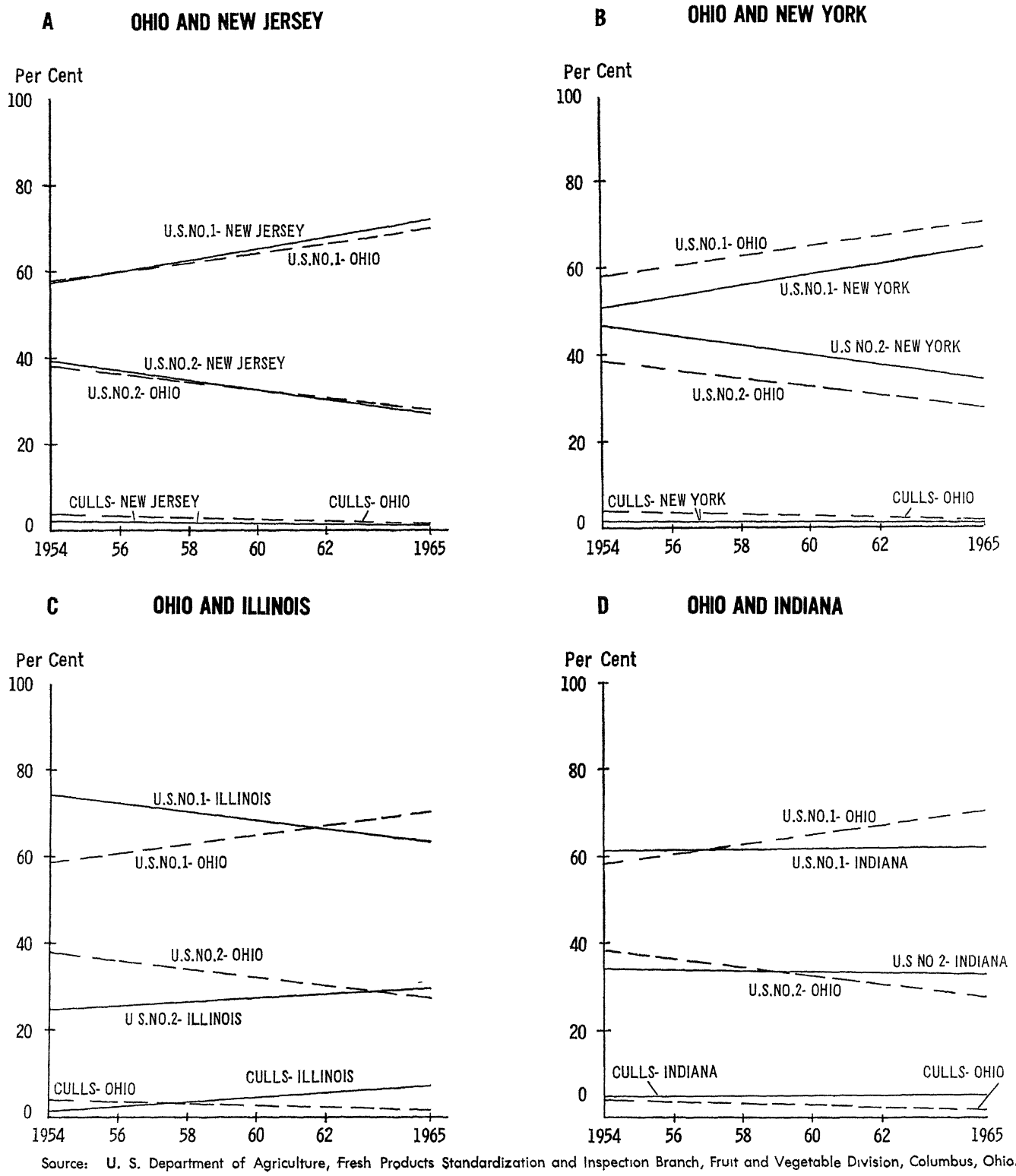
State	U. S. No. 2 Grade: Percent of Total	U. S. No. 2 Grade: Percent Annual Change
Ohio	33.6	—0 9
Illinois	26.7	0 4
Indiana	34.5	0 1
New York	41.1	0.0
New Jersey	33.6	—1 1

State	Culls: Percent of Total	Culls: Percent Annual Change
Ohio	2.4	—0 1
Illinois	4.4	0 5
Indiana	4.5	0 0
New York	1.8	—0 1
New Jersey	2.4	—0.1

Source: U. S. Department of Agriculture, Standardization Section, Fresh Products Standardization and Inspection Branch, Fruit and Vegetable Division, in Ohio, New Jersey, New York, Indiana and Illinois.

[3]Grades administered by the buyer are typically referred to as minimum grades. The minimum grade level for merchantable tomatoes frequently varies with supply and demand conditions.

Fig. 8.—Trends in Proportion of Processing Tomatoes in Each Grade, Ohio, Indiana, Illinois, New Jersey, and New York, 1954-65.



Source: U. S. Department of Agriculture, Fresh Products Standardization and Inspection Branch, Fruit and Vegetable Division, Columbus, Ohio.

8F. Ohio's level and rate of change for U. S. No. 1, U. S. No. 2, and culls are presented in each figure to provide a comparison of Ohio's raw stock quality with that of other supply states. These graphs reveal that Ohio's and New Jersey's qualities are very similar, New York's quality level is about 7 percentage points below Ohio's level with about the same rate of change, Illinois's quality materially decreased while Ohio's increased, and Indiana's quality reveals a slight decrease while Ohio's increased.

OHIO'S PROCESSING TOMATO INDUSTRY

Marketing of Processing Tomatoes

The marketing of processing tomato raw stock is a greater task (as measured by physical weight and perishability) than the marketing of corn or soybeans from the same area of land. A 40 bushel yield per acre soybean crop requires that 1.2 tons of product be marketed from each acre while in 1965 a total of 21.7 tons was marketed for each acre of tomatoes. In addition, the tomatoes are much more perishable and their farm value per pound is less than half that of soybeans. Tomatoes must be processed within hours of their harvest while soybeans can be stored for months or even years.

The direct costs of harvesting labor are equal to about one-third of the gross receipts for tomatoes. In addition, growers of processing tomatoes must house and manage the harvest labor. Many potential processing tomato growers have decided against entering the industry because of high labor costs, relatively high transportation requirements, the need for procuring housing, and the need for supervising the harvest labor.

The average acreage produced per grower continues to increase. With this increase there has been a need for more capital for labor housing, sprayers, transplanters, trucks, hampers, fertilizer, and other production inputs. In addition to increased capital needs, entry into growing also depends upon the availability of contracts from tomato processors. With the recent plant expansion in Ohio, contract availability is currently not a restriction to entry.

Contracting

Ohio's processing tomato crop is produced and marketed under a contract between the grower and the processor. The contract normally is signed prior to planting the crop.

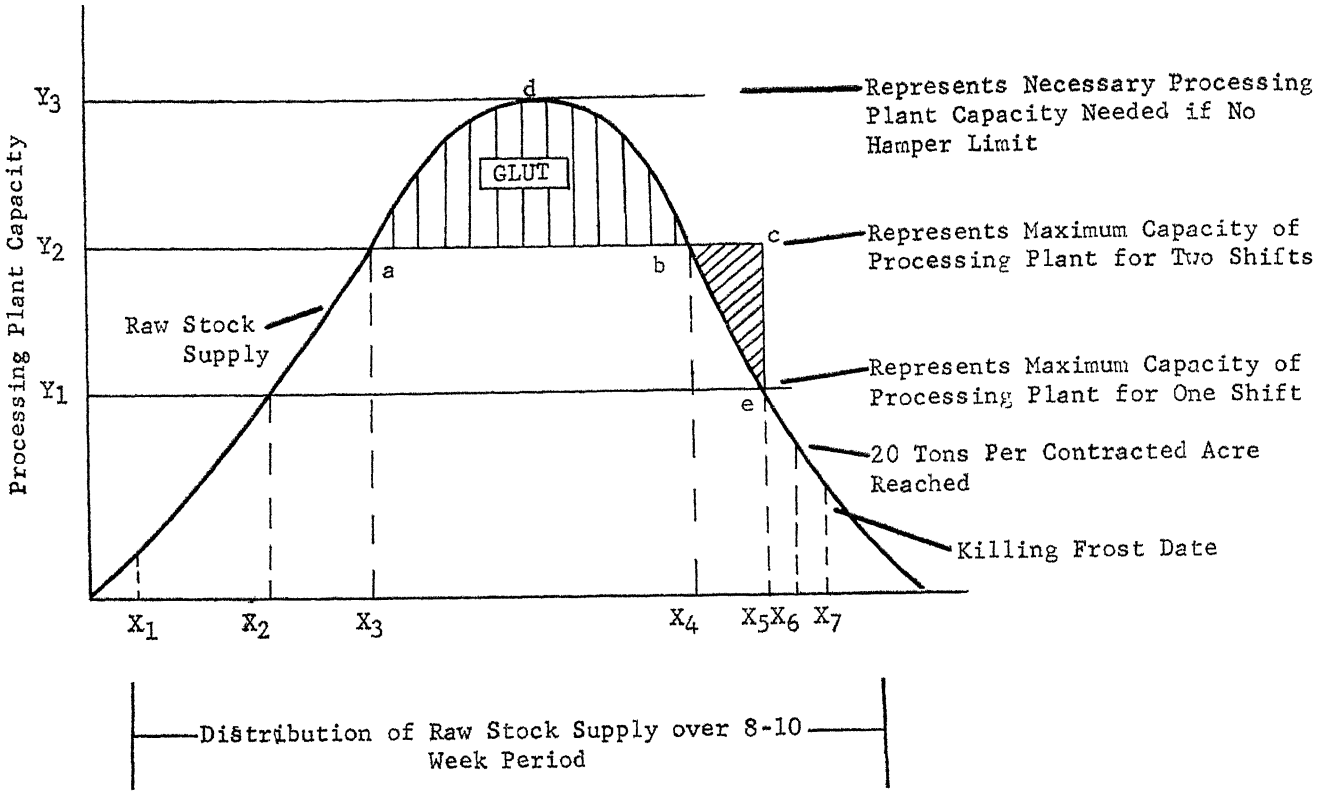
During the early portion of each calendar year, each processor makes a projection as to the amount of processing tomato raw stock needed for the summer pack and estimates the acreage needed to produce this supply of raw stock. Based upon these needs and on the estimate of the price needed to obtain the desired acreage, contracts with a definite price and other provisions are offered to prospective growers of processing tomatoes. Contracts are usually made in February, March, and April.

Each Ohio processor has a different contract but in general the price, terms, and conditions of sale are similar. Prices paid to growers are typically based on fixed prices per ton for processing tomatoes of specified grades delivered by growers. Terms and conditions include delivery point for tomato raw stock, acres, varieties to be planted, opening and closing dates for receiving raw stock, cost of tomato plants, hamper rental, inspection costs, daily hamper limit provisions expressed in hampers per acre per day to be used in the event the volume of crop moving into a given processing plant exceeds its capacity, total tonnage limitation in event a processor receives the projected tonnage requirement prior to the close of the harvest season, and merchantable tomatoes in respect to minimum percentage of No. 1 and maximum percentage of culls.

Virtually all processing tomatoes in Ohio are produced under contract. The demand for non-contracted or open market tomatoes may exist during the first and last 2 to 3 weeks of the processing season. The normal Ohio tomato processing plant operates over a range of 8 to 10 weeks each year. During the heavy crop movement, tomato processing plants are normally operated at full capacity. Consequently, there is no demand for open market tomatoes during this period. There is, however, some open acreage of tomatoes planted in Ohio for the fresh market trade, the balance of which may be marketed to processors when there is a demand for additional raw stock.

Open market purchasing by processors is more prevalent along the eastern shore of the United States than in the Midwest. Considerable acreage along the eastern shore is produced for the fresh market trade, with the first pickings going to the fresh market and the balance of the crop moving primarily into independent processing plants. Tomato marketing auctions have been established in the eastern area to facilitate the exchange function between buyer and seller. Due to the large acreage of open market tomatoes planted, some processors limit their contracted acreage with the expectation of obtaining a portion of their raw stock requirements from the open market acreage. Price paid for open market processing tomatoes is determined largely by short-run supply and demand forces. Consequently, they lack price stability. This explains the large fluctuations of yearly prices paid for processing tomatoes within the processing tomato area along the eastern shore

Fig. 9.—Relationship between Processing Plant Capacity and Flow of Raw Stock.



compared to those paid for processing tomatoes in Ohio. The major supply of processing tomato raw stock produced in the Midwest and California is from contracted acreage.

Contracting provides a means by which processors and growers can best adjust supply of raw stock to plant capacity and sales. This provides growers with certainty of price, acreage, varieties, and other terms of sale and the processor with greater certainty of supply for efficient operation. Since uncertainty of supply and price leads to economic waste as a result of shortages and surpluses, contracting has minimized economic waste in the Ohio tomato processing industry. Even so, surpluses or shortages occur when yields per acre are markedly higher or lower than those used by the processor in estimating tonnage.

Conceptualizing Tomato Supply and Processing Capacity

Several problems exist due to the biological nature of tomato ripening and to the nature and capacity of processing plants. Because of these problems, each processor normally places a limit on the quantity of tomatoes that can be delivered per acre per day by any grower when supply exceeds processing capacity. He also normally specifies a cut-off date or maximum delivered tonnage per acre or both. The following illustration explains the reasons for these frequently controversial provisions.

The relationship between volume of processing tomatoes produced on the contracted acreage and the capacity of the processing plant is presented in Figure 9. The Ohio harvest normally extends over a period of 8 to 10 weeks.

Y_2 represents the maximum capacity of a hypothetical Ohio processing plant. It is assumed that maximum capacity is based on a 20-hour per day operation, 6 days per week, with the other 4 hours each day used for clean-up. It is also assumed that the contract between grower and processor provides for a daily hamper limit of 30 per day per acre, with a cut-off limit at 20 tons per acre.

X_1 represents the starting harvest and processing date, normally in late July or early August. X_7 represents the end of the raw stock production season, which is normally late in September or early in October.

At the beginning of the harvest season, there is normally a period of 2 to 3 weeks when the supply of raw stock is less than the maximum capacity of the processing plant. This period of time is represented

by the distance between X_1 and X_3. During the early harvest and processing period, represented by the distance between X_1 and X_2, the quantity of raw stock delivered to the processing plant will not be enough for a full 10-hour shift. Consequently, the processing plant will operate either a partial shift or a full shift for less than 6 days per week. As the harvest season progresses, point X_2 is reached where the maximum processing plant capacity, represented by Y_1, is reached for a single shift. At point X_2, the second shift is started partially and reaches maximum capacity at point X_3. Between X_3 and X_4, the plant operates at full capacity. During the period between X_1 and X_3, there may be some demand for open market tomatoes.

As the season progresses, the supply of raw stock delivered to the processing plant exceeds the level of the maximum processing plant capacity at point X_3. Processing plant management then places the hamper limit into effect to restrict the flow of raw stock delivered to the plant. Y_3 represents the necessary processing capacity needed if no hamper limit is enforced.

As the season continues, point X_4 is reached as processing tomatoes are maturing at a rate equal to the maximum capacity of the processing plant. However, due to the back supply of mature tomatoes unharvested in the fields, the hamper limit needs to remain in effect until point X_5 is reached. At this time the hamper limit is removed. Between points X_4 and X_5, there is no demand for open market processing tomatoes.

The shaded area above the *ab* line represents the processing tomato raw stock which matured and was not harvested due to the hamper limit. The shaded area below the *bc* line represents the quantity of unharvested raw stock which was carried forward on the vines from the area above the *ab* line and harvested later as conditions permitted. Due to losses of ripe raw stock when held in the field, the quantity represented by shaded area *bce* is less than the shaded area *abd*. The difference represents raw product loss.

As the flow of raw stock continues to be delivered, point X_5 is reached when the second shift is discontinued. If the management of this hypothetical processing plant desires more tomatoes, a demand for open market tomatoes may evolve at this point in time. However, the probability of this demand is very unlikely under real Ohio conditions as the management normally expects the balance of his raw stock needs to be obtained from the contracted acreage.

When point X_6 is reached, the quantity of raw stock processed is equal to an average of 20 tons per acre on the aggregate contracted acreage. At this point, management of the processing plant will frequently have the right, in accordance with provisions in the contract with growers, to close the processing plant for the season provided the pack is determined by management to be sufficient. If the processing plant is closed, deliveries of raw stock are stopped. However, if management wishes to pack more than the average 20 tons per acre limit, the processing plant continues to operate for a period after point X_6 is reached.

If the quantity of tomatoes for processing is less than expected or the demand for the processing pack is greater than expected, the management of the processing plant has the opportunity of remaining open until the first killing frost, which is late September or early October.

The use of a hamper limit permits a compromise between the variable flow of raw stock and the fixed capacity of the processing plant. A plant capacity at the level of Y_3 would be uneconomic as the processing plant would be operating at maximum capacity for only a short period of time. The total tonnage limitation is also a compromise between a variable supply and a relatively fixed need of the finished product for the market. The risk carried by growers of not being able to market all of their processing tomatoes in a good crop year is an implicit component of the price. Therefore, if growers were guaranteed a market for these surplus tomatoes, the processor would be forced to adjust his offering price to a lower level.

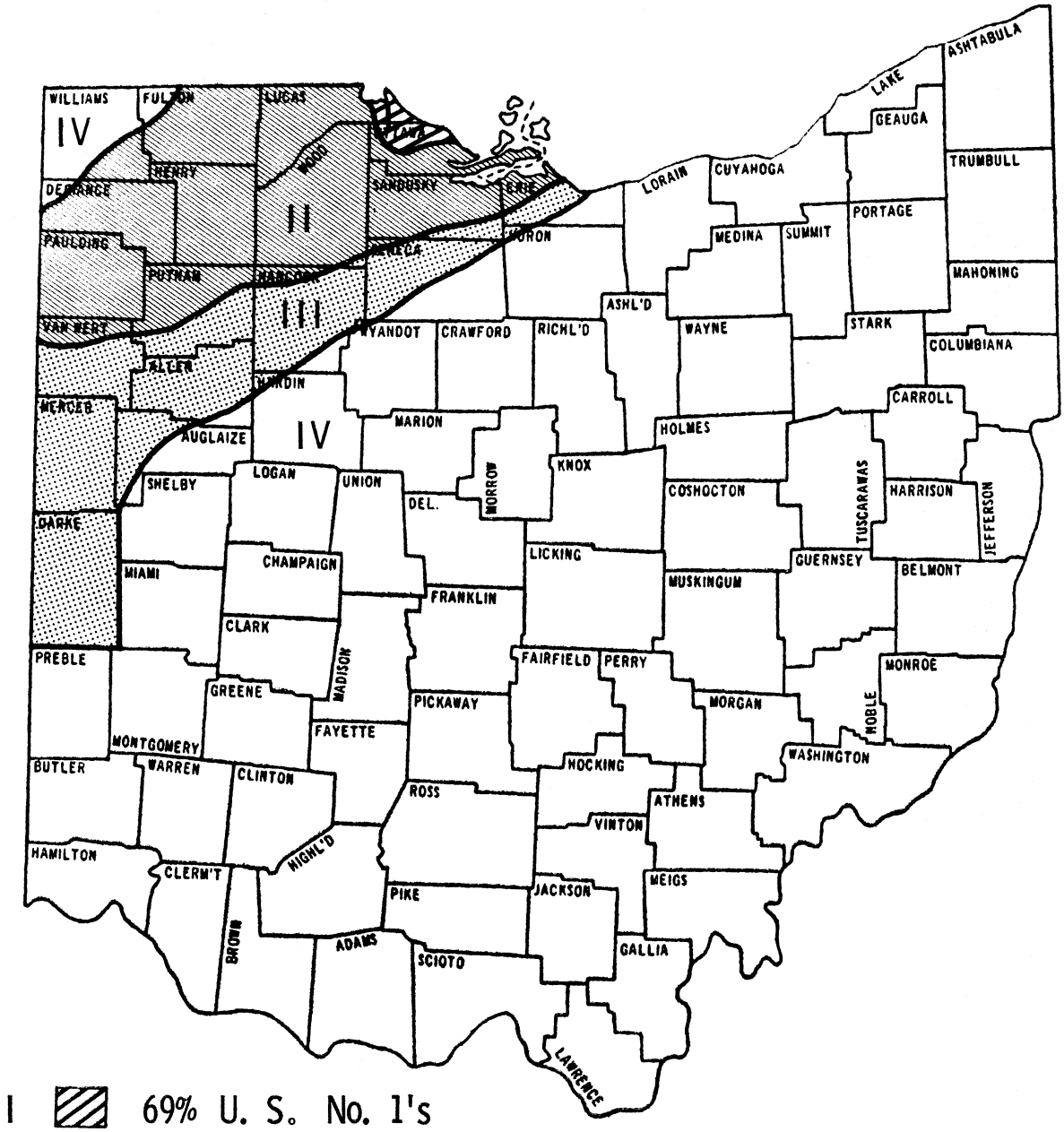
Structure of the Ohio Market

The buying side of the Ohio market structure for processing tomatoes is represented by tomato processors and raw product brokers. The selling side is represented by individual tomato growers and a cooperative marketing association which acts as an agent on behalf of its member growers in bargaining on price and other contract provisions.

In 1965, the buying side of the Ohio market was represented by 19 tomato processors plus one tomato broker. Together they purchased about 96 percent of Ohio's raw stock output. Six of the larger tomato processing firms which operate plants in other states as well as Ohio purchased about 84 percent of Ohio's total output. The remaining 13 processing firms purchased about 15 percent of Ohio's total output and the one broker accounted for less than 1 percent of Ohio's total processing tomato sales.

The selling side of the market was represented by about 1200 tomato growers in 1965. Approxi-

Fig. 10.—Ohio's Processing Tomato Production Area and Distribution of Processing Tomato Production Areas by Quality of Raw Stock Produced, 1952-64.



Source: U. S. Department of Agriculture, Fresh Products Standardization and Inspection Branch, Fruit and Vegetable Division, Columbus, Ohio.

mately 270 of these growers producing about 20 percent of the total supply were organized into a cooperative bargaining association and the remaining 930 growers acted independently. Authorizing the cooperative to act as their sole bargaining agent for the purpose of negotiating price and terms of sale in contracts with buyers of processing tomatoes, association members had signed marketing contracts with their cooperative association. Unorganized growers contracted directly with the processors and received the same price and terms negotiated by the cooperative association.

Member and non-member growers of the cooperative bargaining association all receive the same price and terms of contract. Buyers may contract with non-members prior to final negotiations with the cooperative bargaining association. If price and terms are changed as a result of negotiations, prior contracts with non-members are modified to include the changes which were negotiated by the cooperative bargaining association. Consequently, for any given year, member and non-member individual final contracts provide the same prices and terms for any given buyer.

Ohio Processing Tomato Supply Area

Processing tomatoes in Ohio are produced in about 16 counties in northwestern Ohio. The production area appears as a belt through northwestern Ohio about 65 miles wide running from Lake Erie to the Indiana border (Figure 10). This area includes about 3.4 million acres of cropland.

The highest concentration of Ohio's processing tomato acreage is in counties adjacent to the western end of Lake Erie. In general, as the distance from the lake increases, concentration of acreage decreases. This relationship is indicated in Figures 11 and Table 8.

The major portion of Ohio's processing tomato crop is produced on soil situated in the old lake bed region. Figure 11, which outlines the old lake bed region in Ohio, reveals that there is a high association between the old lake bed region and the major processing tomato production area.

Most soils in the old lake bed region developed from fine-textured calcareous lake sediment derived from a glacial till. The lake bed soils are very fertile but, because of their high clay content, permeability is low and natural drainage is poor.

Experienced processing tomato growers have found that maximum tomato yields are obtained on well drained soils. Consequently, Ohio processing tomato growers plant the crop on their best drained fields, which often have tile spaced from 40 to 75 feet between laterals. Surface drainage and land leveling also contribute to high yields.

TABLE 8.—Percentage of Total Crop Acres in Tomatoes in Ohio Counties Producing Processing Tomatoes, 1959.

County	Crop Acres	Processing Tomato Acres	Percent of Crop Acres Producing Processing Tomatoes
Lucas	87,470	2,384	2.7
Ottawa	101,089	1,771	1.8
Henry	218,100	2,863	1.3
Fulton	205,028	2,554	1.2
Putnam	261,867	2,192	0.8
Mercer	232,534	1,668	0.7
Sandusky	191,154	1,293	0.7
Darke	293,052	1,682	0.6
Williams	186,650	875	0.5
Wood	299,144	1,613	0.5
Erie	88,164	305	0.3
Van Wert	219,029	472	0.2
Allen	166,363	310	0.2
Seneca	258,202	312	0.1
Defiance	185,043	188	0.1
Auglaize	187,921	105	0.1
Total	3,392,391	21,723	0.6*

Source: 1959 U. S. Bureau of Census.
*Weighted arithmetic mean.

Proportion of Cropland in Tomatoes

Resources employed in the production of Ohio processing tomatoes are in competition with resources employed in production of corn, soybeans, and other crops. In 1959, only 0.6 percent of the cropland was devoted to this crop (Table 8). From the standpoint of land resources alone, the potential expansion of Ohio's processing tomato acreage is enormous.

Competition for resources is not the only factor limiting Ohio's processing tomato acreage. Another major constraint is the height of the entry barrier, which is determined by many factors. These include the high cost of inputs per acre relative to those for corn and soybeans, greater risk, higher labor cost, greater recordkeeping, greater transportation cost, greater capital requirements in labor housing, specialized machinery, and the ability of the grower to supervise labor, as well as his ability in obtaining technical knowledge in growing and harvesting the processing tomato crop. In addition, processing plant capacity places an absolute upper limit on contracted acreage for any given year. Processing plant capacity has been the greatest restriction on acreage until recently when additional processing plant capacity was added in Ohio.

Changes in Output Levels from Ohio Farms

Since data for the number and size of Ohio processing tomato growers for a historical period are not

Fig. 11.—Ohio's Old Lake Bed Region and Distribution of Processing Tomato Acreage, 1959.

Old Lake Bed Region

= 100 Acres

Source: Ohio Department of Natural Resources, Division of Lands and Soil, Columbus, Ohio; U. S. Bureau of Census, 1959.

readily available, Wood County was selected as a sample Ohio area to estimate these changes.

During the 10-year period 1956-1965, the average Wood County processing tomato grower increased his acreage at the rate of about 0.5 acre per year (Figure 12F). By 1965, the average Wood County grower was supplying 354 tons from 18.5 acres compared with 160 tons from 14.4 acres 10 years earlier. The change in Wood County is believed to be typical of the total change which occurred in the entire Ohio processing tomato industry during this same period.

As the average output level from each Ohio farm increased, farmer-owned transportation equipment likewise increased in size. In 1952, the average load of processing tomatoes delivered to Ohio receiving stations with Federal-State inspection was 4.42 tons, compared to 7.54 tons in 1965 (Figure 12D). Thus, the size of Ohio's loads of raw stock delivered to processors increased at the rate of about 500 lb. per year during this period.

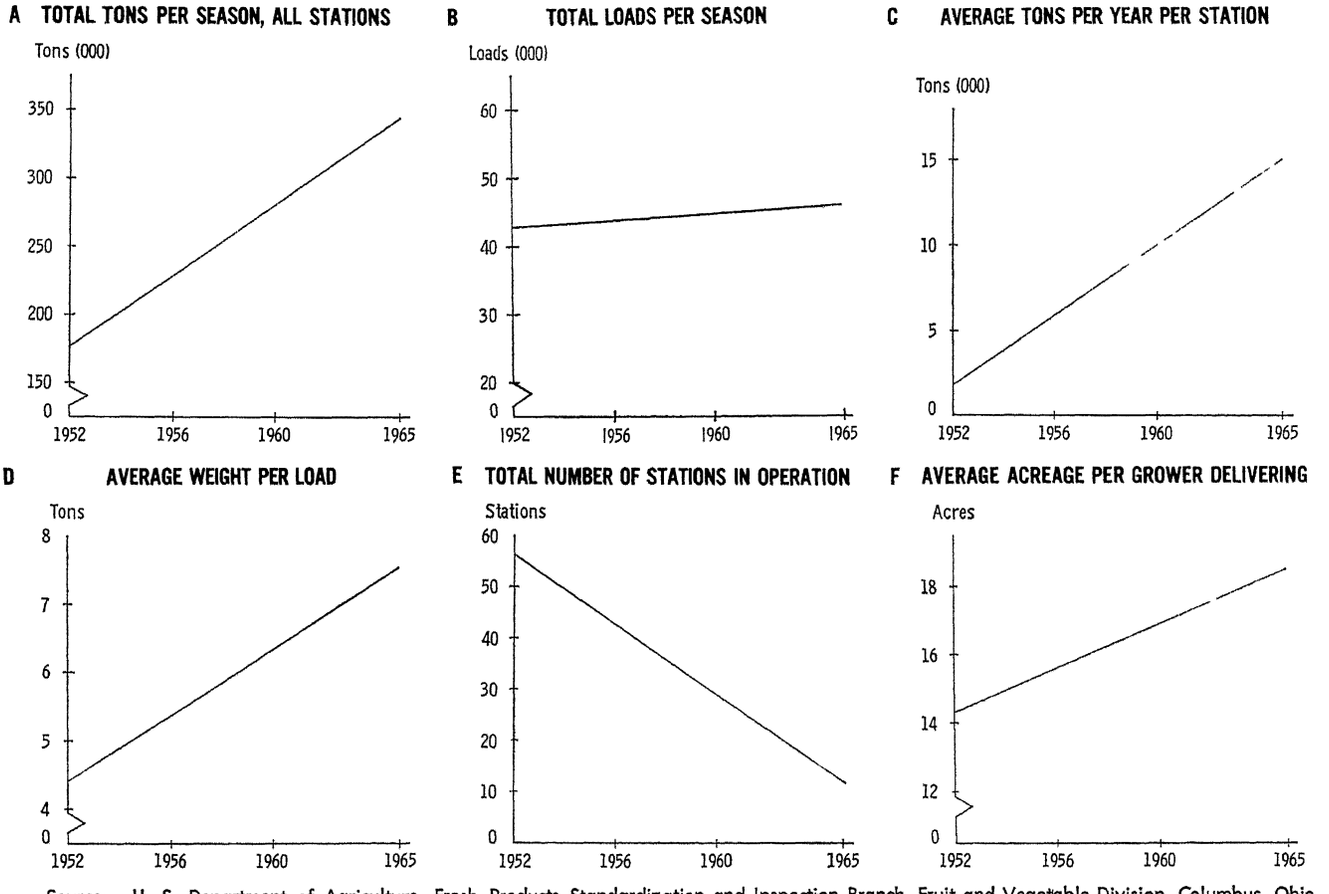
Changes in acres, yields, and size of loads delivered to processors in Ohio reflect the degree of adoption of production and transportation technology associated with economics of scale within the Ohio supply area.

Changes in Collection of Ohio's Supply of Raw Stock

The number of Ohio processing tomato receiving stations with Federal-State inspection declined at the rate of 3.1 stations per year during the 14-year period, 1952-1965 (Figure 12E). Total number of stations decreased from about 56 to 16 during this period. However, the total tons of raw stock received by all Ohio stations with Federal-State inspection increased during this same period at the rate of about 12,000 tons per year (Figure 12A). The average total tons of raw stock received by each Ohio station increased at the rate of about 1,000 tons per year (Figure 12C).

The changes in the collection of raw stock in Ohio resulted in an increase in economic efficiency in the use of Federal-State grading inspection and more efficient transportation of raw stock from farms to processors. During this period, field inspections and unloading stations were eliminated, which resulted in all of the supply being delivered directly to the proc-

Fig. 12.—Description of Tomato Loads Received at Ohio Stations with Federal-State Inspection, 1952-65.



Source: U. S. Department of Agriculture, Fresh Products Standardization and Inspection Branch, Fruit and Vegetable Division, Columbus, Ohio. Wood County Cooperative Extension Office, Bowling Green, Ohio.

essing plants. This eliminated the extra handling and transportation cost for raw stock delivered to field stations.

With these changes, the raw stock received at each Federal-State inspection station increased at the rate of about 1,000 loads per year (Figure 12B).

Raw Stock Quality Variations Within Ohio

The highest quality of Ohio raw stock as measured by percentage of U. S. No. 1 grade over the 13-year period, 1952-1964, has been produced in the Lucas County area east of Toledo and in the approximately northern half of Ottawa County. The raw stock produced in this area annually averaged about 70 percent U. S. No. 1 grade. This area is designated as I in Figure 10.

The area designated as II in Figure 10 represents the area in which the major portion of the Ohio tomato crop is produced. The average raw stock quality produced in this area over the 13-year period, 1952-1964, ranged from 60 to 69 percent U. S. No. 1 grade.

Area III in Figure 10 represents the southern production area, where raw stock quality for the 13 years, 1952-1964, ranged from 48 to 50 percent U. S. No. 1 grade.

A limited acreage of processing tomatoes was produced in Area IV, Figure 10, prior to and during World War II. However, apparently due to natural advantages, processing tomato production in Ohio is now restricted almost exclusively to Areas I, II, and III.

The average grade significantly affects the value of the crop per ton and per acre. For example, assume growers A and B each receive a 20-ton yield and each receive the same contract prices of $35 per ton for U. S. No. 1, $25 per ton for U. S. No. 2, and nothing for culls. If grower A's average grade for the season is 70 percent U. S. No. 1, 29 percent No. 2, and 1 percent culls, A's gross income per acre is $635. However, if grower B's average grade for the season is 50 percent U. S. No. 1, 49 percent U. S. No. 2, and 1 percent culls, B's gross income per acre is $595. The difference between A's and B's gross income per acre is $40. This difference is a result of the variation in average grade.

TABLE 9.—Average Real Price per Ton and Average Annual Rate of Change in Real Price for Processing Tomatoes for U. S., Ohio, and 11 Other Major Supply States, 1954-65.

State	Average Real Price per Ton* 1954-65	Annual Rate of Real Price Change 1954-65	1954-65
	Dollars	Dollars per Ton	Percent
Ohio	27.94	—0.03	—0.11
United States	31.08	0.71	2 31
California	30.70	0.69	2.28
Illinois	31.50	0.00	0.00
Michigan	27.76	0.01	0.04
New York	32.68	—0.14	—0.43
Pennsylvania	32.70	—0.33	—1.01
New Jersey	33.57	—0.08	—0.24
Delaware	32.93	—0.45	—1.37
Maryland	32.65	—0.37	—1.13
Virginia	30.85	—0.01	—0.03
Indiana	27.86	0.01	0.04
Texas	22.83	0.56	2.45

*Expressed in terms of dollars of constant value, 1957-1959 = 100.

COST OF SUPPLY

Most processors purchase their raw stock requirements on a tonnage basis at a price per ton which includes transportation cost from the farm to the processing plant. California is the only exception to this rule. Prior to 1964, California processors purchased tomatoes at the grower's farm at a price referred to in the industry as a roadside price and processors bore the cost of hauling to the plant. Starting with 1964, the reported California price was adjusted to a delivered basis. The California price now is comparable with prices in other states. In 1966, the Crop Reporting Service reported a $6 per ton differential between roadside and delivery prices in California. This represents the transportation cost from the field to the processing plant.

In this study, the transportation real cost was added to all California prices prior to 1964. These adjustments were made to make the data for California and the U. S. comparable for all years.

All prices paid by processors for raw stock during the 12-year period, 1954-1965, were adjusted to "real" prices. This technique removes the inflationary bias from actual or nominal prices. Therefore, the real price or deflated price shows equal purchasing power for each of the 12 years studied..

The average real price paid per ton for raw stock in the U. S. and in each principal state is presented in Table 9. This table also shows the annual rate of change and percentage change.

Real prices paid for raw stock and rates of change for the period 1954-1965 in the U. S. and the 12 major supply states with projections to 1970 are presented in Figures 13A-13F. Ohio's real prices are presented in each figure for comparison.

Ohio's real price decreased at the rate of 3 cents per ton annually during the 12-year period (Table 9). However, Ohio's real price variation from year to year is the lowest of the 12 major supply states (Appendix I, Table III).

Within a market supply area, buyers offer a price level which they expect will provide a predeter-

mined supply of raw stock. In the short run, the quantity of this supply has an upper limit determined either by maximum processing plant capacity or estimated sales potential.

Although data are not available, it is hypothesized that the cost of production for each state supply area is different. Consequently, price of raw stock alone does not determine profit to the grower.

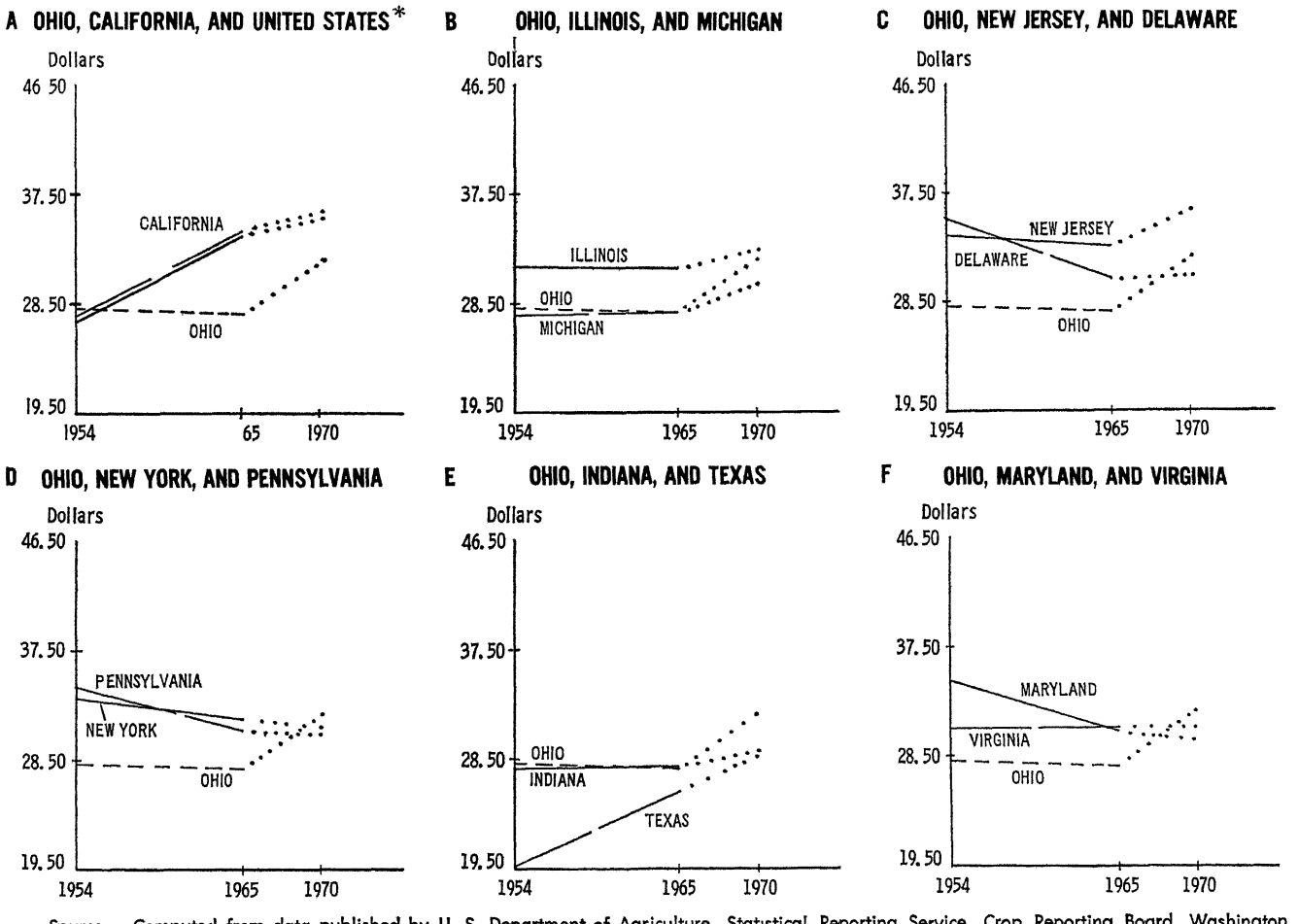
Ohio's real price for the period 1966-1970 is expected to increase at a relatively faster rate than other supply states. This is due to Ohio's additional processing plant capacity, which has resulted in a shift of the demand schedule for the supply of Ohio's raw stock. This will raise Ohio's equilibrium real price level in relation to other supply states.

In the short run, buyers' offering prices in the Ohio supply area are determined by the magnitude of expected sales and prices of competing crops, such as soybeans and corn. Prices offered for raw stock must be sufficient to continue to stimulate production of processing tomatoes as a substitute crop for soybeans and corn. In a growth period when plant capacity is being increased and an increased supply of raw stock is needed, price offerings will be increased to a higher level where some non-growers will be willing to hurdle the entry barrier and come into the industry by employing a portion of their resources in the production of tomatoes. Appendix II explains the effects of adding processing plant capacity on demand and price of raw stock.

A supply area will increase production when the cost of the finished tomato product plus transportation cost is at a level where the product may be shipped to an outside consumption area and is competitive in price with tomato products from other supply areas. The Ohio processing tomato area is now in this competitive position.

In 1965, the Ohio supply area produced twice the quantity of raw stock needed by the state's population. Consequently, half of the supply of processed

Fig. 13.—Comparison of Real Prices per Ton of Processing Tomatoes, Ohio and Major Supply States, 1954-65, with Projections to 1970.



Source: Computed from data published by U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington, D. C. Vegetables-Processing Annual Summaries. Real income computed by using 1957-59 wholesale price index = 100.

TABLE 10.—Average Real Gross Income per Acre and Average Anuual Rate of Change in Real Gross Income per Acre for Processing Tomatoes in U. S., Ohio, and 11 Other Major Supply States, 1954-65.

State	Average Real Gross Income per Acre* 1954-65	Average Annual Rate of Change in Real Gross Income per Acre 1954-65	1954-65
	Dollars	Dollars	Percent
Ohio	416	27.48	6.61
United States†	419	31.57	7.53
California†	547	22.85	4.17
Illinois	448	22.55	5.03
Michigan	316	15.93	5.04
New York	335	12.95	3.87
Pennsylvania	339	20.65	6.09
New Jersey	449	37.03	8.25
Delaware	419	30.94	7.38
Maryland	316	20.67	6.54
Virginia	166	13.45	8.10
Indiana	310	19.87	6.41
Texas	95	9.74	10.25

Source: U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington, D.C., Vegetables-Processing Annual Summaries, 1954-65.

*Expressed in terms of dollars of constant value, 1957-59 = 100.

†California's real gross income per acre prior to 1964 was adjusted to a delivered basis. U. S. real gross income prior to 1964 was proportionally adjusted. All computations are based on a delivered basis.

tomato products was transferred out of Ohio to other consumption markets.

It is hypothesized that Ohio's price level for raw stock is placing processors in an advantageous position to increase plant capacity. With the many concentrated consumption areas situated outside of Ohio but relatively close to the Ohio supply area, the Ohio processing tomato industry is in an economic environment favorable for growth.

GROSS INCOME PER ACRE

Gross income per acre, the product of yield per acre and price per ton, provides a useful basis for the comparison of different supply states in an economic analysis of tomato production from the growers' point of view. All values are in terms of "real gross income," which indicates gross income as constant 1957-1959 dollars.

Average real gross income per acre and annual rate of change for the 12-year period, 1954-1965, for the U. S. and the 12 major supply states are presented in Table 10. Real gross income per acre and the rate of change in the U. S. and the 12 major supply states for 1954-65, with projections to 1970, are presented in Figures 14A-14F.

Ohio's average real gross income per acre for the 12-year period was $416.[4] The average real gross income at the start of the period was $265 per acre. The real gross income per acre increased at the rate of $27.48 annually, making a real gross income per acre of about $600 at the end of the period.

Since the level in real price per ton in Ohio was very stable over this period (Table 3), the increase in real gross income per acre in Ohio is explained by increased yields.

For the period 1954-1965, Ohio ranked fourth in annual rate of increase in income per acre from processing tomatoes. Ohio was exceeded by New Jersey, Delaware, and California, where higher price levels per ton caused the higher ranking. In 1965, Ohio ranked second, with only California exceeding the state in gross income per acre.

To make comparisons of net income per acre for the 12 states, it would be necessary to consider cost of production figures. These are not currently available.

[4]Computed values for regression line trends for processing tomato real gross income per acre for 12 states and the U. S. for the 12-year period, 1954-1965, are tabulated in Table IV, Appendix I.

SUMMARY AND CONCLUSIONS

Summary

U. S. Demand: Per capita consumption of processing tomatoes in the U. S. is now about 48 lb. farm weight and has been increasing at the rate of 0.5 lb. annually. Total demand for processing tomatoes reached a level of about 4.5 million tons during the recent 2-year period, 1964-1965. With an expected net population growth of 1.5 percent annually for the period 1965-1970, demand is expected to increase at the rate of about 60,000 tons annually.

U. S. Supply: Total supply of processing tomatoes in the United States increased at the rate of about 64,400 tons per year during the 12-year period, 1954-1965. California, Ohio, Illinois, Michigan, and New Jersey are the major states which contributed to this increase in supply. Supply from all other states declined. Only California contributed more to the increased supply than Ohio.

Raw Stock Utilization: More raw stock is used for tomato juice than for any other processed product. Canned tomatoes and catsup are about equal in second place, followed by paste, pulp, and puree. Raw stock used for the manufacture of catsup is increasing faster than for any other product.

Ohio's Growth as a Supplier of Raw Stock: Ohio now ranks second to California as a supplier of raw stock. In 1965, California supplied about 57 percent of the U. S. total supply and Ohio supplied about 12 percent, compared with the 10-year period, 1950-1959, when California supplied 54 percent and Ohio 5.7 percent of the total.

Ohio and California were the only major supply states having a net acreage increase. California and

Ohio acreage increased at the rate of about 2,500 and 500 acres per year, respectively. Ohio had the largest percentage increase, 4.5 percent, compared with California's 1.8 percent increase.

In addition to Ohio's 500 acre annual increase, yields in the state increased at the rate of 1 ton per acre annually and are currently higher than any state other than California. The percentage of U. S. No. 1 grade tomatoes in Ohio increased about 1 percent annually for the 12-year period, 1954-1965.

Ohio had less year-to-year variation in processing tomato grade quality than any other supply state where comparable data were available.

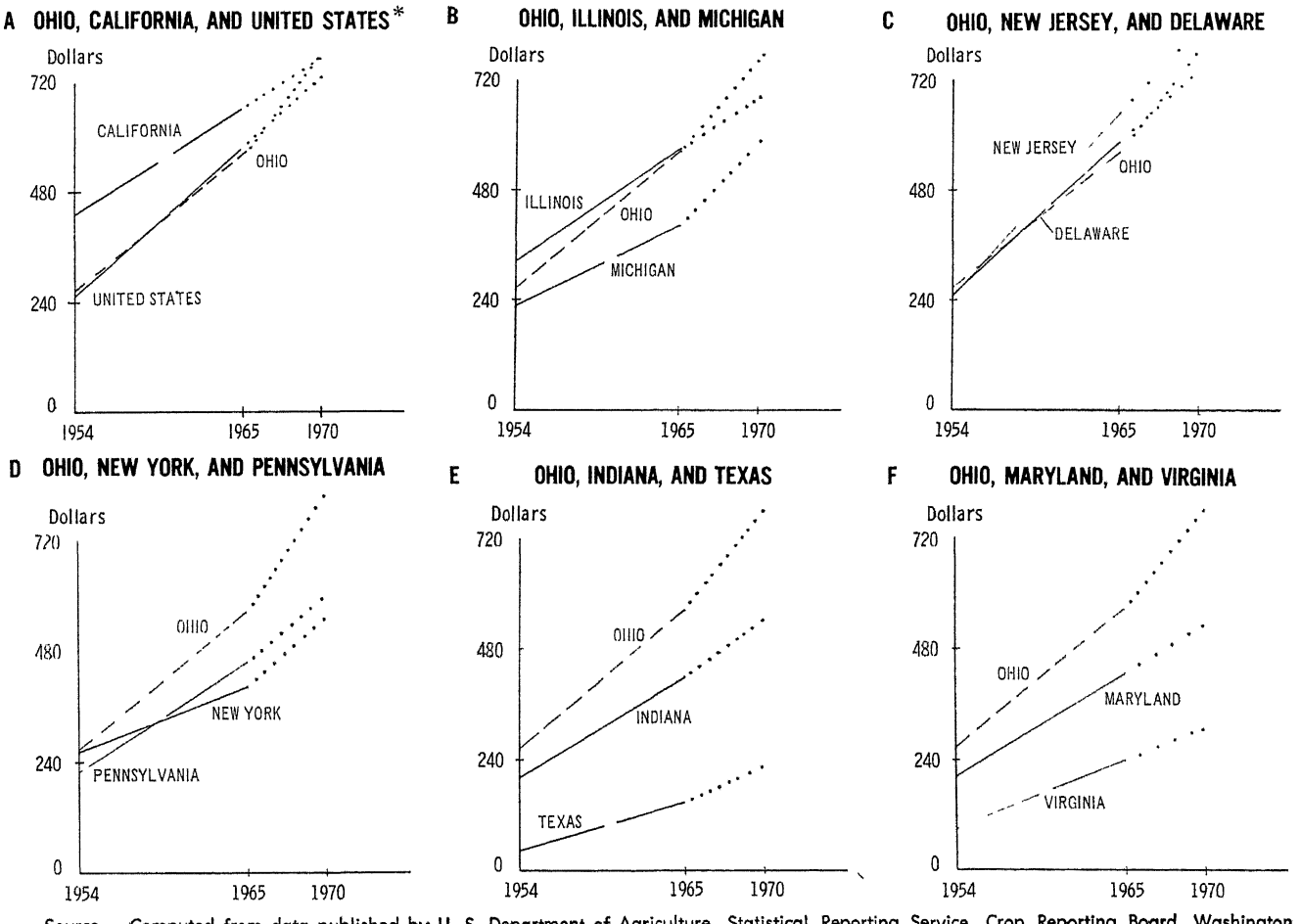
Marketing Ohio's Supply: It is estimated that about 75 to 80 percent of Ohio's raw stock supply is now being graded by the Federal-State Inspection Service.

Virtually all of Ohio's supply of processing tomatoes is contracted with about 1,200 growers at a "delivered firm price" prior to planting. This marketing technique has minimized economic waste in the Ohio processing industry.

Ohio's supply is produced in about 16 counties in northwestern Ohio, with the highest acreage concentration in Lucas County. Only 0.6 percent of the total cropland in the 16-county area is now devoted to the production of processing tomatoes. Thus Ohio has a tremendous land resource potential for increasing acreage in processing tomatoes. Constraints on processing tomato acres are corn and soybeans competing for resources and other factors affecting height of entry barrier, including processing plant capacity.

The average Wood County grower marketed 235 tons from 18.5 acres in 1965. Acreage per grow-

Fig. 14.—Comparison of Real Gross Income per Acre for Processing Tomatoes, Ohio and Major Supply States, 1954-65, with Projections to 1970.



Source: Computed from data published by U. S. Department of Agriculture, Statistical Reporting Service, Crop Reporting Board, Washington, D. C. Vegetables-Processing Annual Summaries. Real income computed by using 1957-59 wholesale price index = 100.

*Prior to 1964, California prices were reported on basis of "roadside pick-up." Starting with 1964, prices were reported delivered to the processing plant, which is comparable to prices in other states. Adjustments were made to California prices prior to 1964 to include transfer cost from field to processing plant. Average U. S. prices were likewise adjusted, making real gross income in California and U. S. comparable with other supply areas.

er has been increasing at a rate of about 0.5 acre per year. Receiving stations in Ohio are now operated only at processing plants.

In a good crop year, a processing plant operating at a high level of efficiency will typically have a greater flow of raw stock available for processing at the peak of the harvest season than it has processing capacity. When the flow of raw stock exceeds processing plant capacity, hamper limits per acre per day are used to restrict the flow of raw stock. During this period, flow level is adjusted to the maximum capacity of the processing plant. Total tonnage limitations are occasionally used to equate total supply of raw stock to sales potential. The contract price implicitly includes the growers' risk factor of inability to market an entire crop.

Ohio's real price of raw stock had less variation during the 12-year period, 1954-1965, than in any other supply area. Ohio's real price decreased at an annual rate of about 3 cents per ton. During this period, Ohio supplied raw stock to the market at a lower price than that paid in 8 of the 12 other major supply states.

Ohio's expected real price for the period 1966-1970 is predicted to increase at a relatively faster rate than that of other supply states. The predicted greater increase in Ohio's real price is due primarily to the shift in demand for Ohio's raw stock. This shift in demand is the result of an increase in Ohio's processing plant capacity.

Ohio's average real gross income from processing tomatoes averaged $416 per acre during the 12-year period, 1954-1965. Income increased at the rate of $27.48 per acre annually due to increasing yields. At the end of this 12-year period, the average Ohio grower grossed about $600 in real dollars[5] per acre.

[5]Real in terms of 1957-1959 dollars.

Conclusions

For the past 12 years, the production of processing tomatoes in Ohio has been increasing. Gross returns per acre to Ohio growers have increased relative to those in other states. At the same time, the price of tomatoes per ton in Ohio has remained about constant and prices in other states have increased. This factor, along with Ohio's relatively high grade of tomatoes and good location relative to markets, places the industry in a favorable position for expansion. Present yield levels per acre indicate that Ohio growers are able to produce processing tomatoes more efficiently than in most states.

In addition, the Ohio supply area is favorably situated in respect to transportation facilities, such as railroads, turnpikes, interstate highways, and port facilities; population centers; and labor supply. Transportation facilities within the area allow considerable latitude for processing plant locations. Water supply for processing plants is adequate.

As aggregate demand causes tomato processing plant capacity to increase in the United States, management in the tomato processing industry will increase capital investments in supply areas where economic returns are the greatest. This analysis indicates that the Ohio supply area will receive a priority rating for increasing capital investment in tomato processing plant capacity. This analysis also indicates that the Ohio processing tomato industry has just recently started its expansion and should be expected to continue to increase its plant capacity.

Ohio yields are expected to continue to increase at the rate of about 1 ton per acre per year. It is also expected that an additional 5,000 acres will be devoted to production of processing tomatoes by 1970. Consequently, it is expected that the total supply in 1970 will exceed 700,000 tons in the Ohio supply area. Ohio's acreage will increase to the extent that the state's processing plant capacity increases.

APPENDIX I

COMPUTED VALUES FOR LINEAR TREND REGRESSION LINES

TABLE I.—Computed Values for Regression Time Trends for Processing Tomato Yields in Tons per Acre for 12 Major Supply States and the U. S., 1954-65.

State	M	a	b	sy	V
California	17.73	15.88	0.34	1.56	0.09
Ohio	14.89	9.47	0.99	2.53	0.17
New Jersey	13.48	7.26	1.13	2.73	0.20
Illinois	14.22	10.41	0.69	1.38	0.97
New York	10.25	7.84	0.44	1.65	0.16
Michigan	11.38	8.30	0.56	1.14	0.10
Delaware	12.93	7.05	1.07	2.90	0.22
Pennsylvania	10.50	6.42	0.74	1.86	0.18
Indiana	11.13	7.27	0.70	1.78	0.16
Maryland	9.73	5.71	0.73	1.90	0.20
Virginia	5.73	2.97	0.44	0.83	0.15
Texas	4.08	2.21	0.34	0.58	0.14
United States	13.75	9.78	0.72	0.97	0.07

M = Computed mean yield level for trend period measured in tons per acre.
a = Yield level at the start of the trend period measured in tons per acre.
b = Annual rate of yield increase measured in tons per acre.
sy = Standard error for the trend line measured in tons per acre.
V = Coefficient of variation, a measurement of relative dispersion.

TABLE II.—Computed Values for Regression Time Trends for Processing Tomato Acreage for 12 Major Supply States and the U. S., 1954-65.

State	M	a	b	sy	V
California	133,650	119,835	2,512	23,787	.18
Indiana	25,158	31,876	—1,221	2,579	.10
Ohio	19,967	17,244	499	2,651	.13
New Jersey	19,350	23,900	—823	2,410	.12
Pennsylvania	14,950	22,812	—1,429	1,727	.12
Texas	11,825	19,092	—1,321	3,221	.27
New York	10,500	14,046	—625	1,537	.15
Virginia	10,025	13,185	—575	1,386	.14
Maryland	9,900	12,981	—560	1,093	.11
Illinois	9,025	10,135	—202	615	.07
Michigan	6,650	7,165	—94	913	.14
Delaware	2,717	4,655	—352	931	.34
United States	297,167	326,398	—5,315	33,176	.11

M = Computed mean acreage level for trend period.
a = Acreage level at start of trend period.
b = Annual rate of acreage increase.
sy = Standard error for the trend line.
V = Coefficient of variation, a measurement of relative dispersion.

TABLE III.—Computed Values for Regression Time Trends for Processing Tomato Real Prices per Ton for 12 Major Supply States and the U. S., 1954-65 (1957-59 = 100).

State	M	a	b	sy	V
New Jersey	33.57	33.99	—0.076	2.51	.07
Delaware	32.93	35.41	—0.451	2.04	.06
Pennsylvania	32.70	34.50	—0.327	1.82	.06
New York	32.68	33.46	—0.143	1.31	.04
Maryland	32.65	34.66	—0.367	1.83	.06
Illinois	31.50	31.52	—0.004	1.75	.06
Virginia	30.85	30.78	0.012	2.45	.08
Ohio	27.94	28.12	—0.034	0.81	.03
Indiana	27.86	27.80	0.012	1.10	.04
Michigan	27.76	27.71	0.008	1.09	.04
California	31.44	26.94	.692	2.89	.12
Texas	22.83	19.76	.559	2.72	.12
United States	31.03	26.44	.706	1.80	.10

M = Computed mean processing tomato real price per ton.
a = Real price level per ton of processing tomatoes at the start of trend period.
b = Annual rate of price per ton increase.
sy = Standard error for the trend line measured in use dollars per ton.
V = Coefficient of variation, a measurement of relative dispersion.

TABLE IV.—Computed Values for Regression Time Trends for Processing Tomato Real Gross Income per Acre for 12 Major Supply States and the U. S., 1954-65 (1957-59 = 100).

State	M	a	b	sy	V
California	558	409	22.85	80.67	.20
New Jersey	449	246	37.03	82.17	.18
Illinois	448	324	22.55	54.10	.12
Delaware	419	249	30.94	94.17	.22
Ohio	416	265	27.48	74.06	.18
Pennsylvania	339	219	21.63	57.41	.17
New York	335	263	12.95	54.58	.16
Maryland	316	202	20.67	69.42	.22
Michigan	316	228	15.93	31.49	.10
Indiana	310	201	19.87	51.03	.16
Virginia	166	92	13.45	29.53	.18
Texas	95	42	9.74	17.27	.18
United States	434	229	31.57	46.74	.28

M = Computed mean processing tomato real gross income per acre,
a = Real gross income per acre at the start of the trend period.
b = Annual rate of real gross income per acre increase.
sy = Standard error of the trend line measured in real dollars per acre.
V = Coefficient of variation, a measurement of relative dispersion.

APPENDIX II

CHANGE IN PRICE AND PRODUCTION OF RAW STOCK AS RELATED TO CHANGE IN INDUSTRY PROCESSING PLANT CAPACITY

Individual processing tomato growers face a perfectly elastic demand schedule for raw stock (Figure IA). For a given year, the price paid per ton to the firm is the same regardless of the amount supplied by each grower. Price paid for raw stock in a given year depends upon the demand and supply relationship within the Ohio supply area, which is referred to as the industry (Figure IB).

Figure I shows the determination of raw stock price, quantity purchased by the industry, and the price paid to firms for the production of raw stock. The output axis of the industry diagram is considerably compressed as compared with that of the firm's diagram. The price axes of the two diagrams are identical. The industry demand curve for raw stock is shown as DD in the industry diagram. The horizontal summation of all individual firm supply curves establishes the industry short-run supply curve SS. The short-run equilibrium price paid firms for the production of raw stock is P. Quantity purchased by the industry is Q.

When the industry adds processing plant capacity, the demand curve for raw stock shifts to the right, as represented by D_1D_1. The shift in demand will cause a shortage of raw stock at the old price, P. Industry will bid up the price in order to obtain the increased quantity of raw stock represented by Q_1 in the industry diagram. The higher price paid firms for production of raw stock is now represented by P_1 in the firm diagram.

This model illustrates the major forces which cause price of raw stock to increase when processing plant capacity is added in a given supply area.

$/Ton	=	Price per ton of raw stock
Q/ut	=	Quantity or output per unit of time
DD	=	Demand curve for the industry
D_1D_1	=	Demand curve for the industry after an increase in processing plant capacity
SS	=	Supply curve for the industry
P	=	Price level per ton of raw stock at equilibrium
P_1	=	Price level per ton of raw stock at equilibrium after an increase in processing plant capacity
dd	=	Demand curve for raw stock faced by the firm
d_1d_1	=	Demand curve for raw stock faced by the firm after an increase in processing plant capacity
Q	=	Quantity of raw stock which will be supplied by all firms at price level P
Q_1	=	Quantity of raw stock which will be supplied by all firms at price level P_1

Fig. I.—Short-run Equilibrium Price of Raw Stock as Related to a Shift of the Industry Demand Curve.